

ALPHA MAGNETIC SPECTROMETER (AMS)

ACCEPTANCE DATA PACKAGE

FOR

AMICA STAR TRACKER

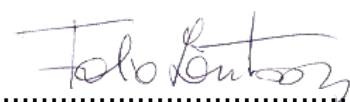
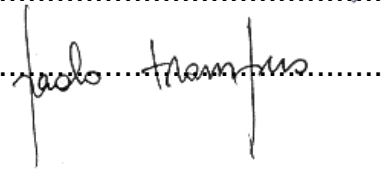
PART NUMBER:
240.000

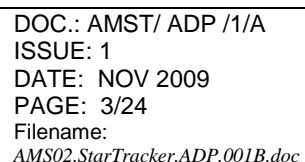
SERIAL NUMBER:
001

AMICA FOR AMS02 ADP Data Package

DOC.: AMST/ ADP /1/A
ISSUE: 1
DATE: NOV 2009
PAGE: 2/24
Filename:
AMS02.StarTracker.ADP.001B.doc

TITLE	ADP DATA PACKAGE
DOCUMENT TYPE	REPORT
DOC No.	AMST/ ADP /1/A
ISSUE No.	1
DATE	Nov 2009

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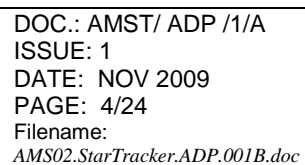
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1. SCOPE

Scope of this document is to define the contents of the Acceptance Data Package (ADP) for AMICA (Astro Mapper for Instrument Check of Attitude) Star Tracker which determines accurately the position of the AMS payload at the exact time that an event occurs of AMS02. It includes the system description and a list of documents in the separate files.

2. SYSTEM DESCRIPTION

The Space Station, which is large and fairly flexible, cannot measure its own position with a high degree of accuracy and thus cannot directly tell the AMS-02 where it is exactly and where it is pointing. To optimize science from the Tracker detector carried by AMS it is important to have the capability to determine accurately the position of the AMS payload at the exact time that an event occurs. To accurately determine its position, AMS carries a Star Tracker called AMICA (for Astro Mapper for Instrument Check of Attitude). AMICA is equipped with a pair of small optical telescopes (AMICA Star Tracker Cameras or ASTCs). The ASTCs are mounted to the upper Vacuum Case Conical Flange on opposite sides of AMS to increase the probability that one has a clear view of the stars. The positioning of the Star Trackers while in the Shuttle Payload Bay does not place the ASTCs within nominal EVA translation paths. The location atop of the tracker places the ASTCs outside of EVA translation paths on the ISS and EVA operations that may be performed on the AMS-02 are not in proximity of the Star Trackers.

Each camera acquires an image of the stars with a Charged Coupling Device (CCD) detector and compares the resultant image to an on-board sky map. With this information, the attitude of AMS can be determined within a few arc-seconds (arc-sec) accuracy.

The hardware consists of an optics system [f/1.25 lens with 75 mm focal length and a 6.3° X 6.3° field of view (FoV)]; a lens cover containing a 3 mm thick blue filter and a 2 mm thick red filter; a low noise frame-transfer CCD (512 X 512 pixels); and a baffle to limit the stray light intrusion to the optics. The baffle is made of black anodized aluminum Al 6061 that is 1 mm thick, the exterior covered with silver coated Teflon.

The baffle is not mechanically connected to the lens assembly and is supported independently by a bracket mounting the baffle to the M-Structure, the configuration allowing for relative motion between the baffle and the lenses without leaking light into the optical path. The interface between the baffle and the lens assembly is made light tight by a fabric MLI cover.

The interior of the baffle is being considered sharp enough to cut EVA gloves, the interior of the baffle cannot be rounded to meet the sharp edge requirements without losing the optical properties of a baffle to limit stray light. This will be controlled with an EVA keepout zone for each baffle.

The AMICA lenses utilize standard optics mounting techniques attaching to the housing body and in the construction of the lenses and filters. There is no specific venting paths provided for in the design of the lens assemblies, however the threaded body provides ample venting paths as shown during venting tests.

The enclosed volume of the Star Tracker is vented through the fastener access holes that are used for tool access when installing the Star Tracker to the AMS-02.

The AMICA operates on +5, ±12 Vdc and converts power internally to +35 V, +12 V, +7 V and +5 V distributed power. One small section of the circuitry operates at a maximum of +45 V. The boards are conformally coated to reduce any potential for high voltage effects. The ASTCs are interfaced to the M-crate located on the ram side by two cables, one 8 conductor 24 AWG shielded cable to provide the SpaceWire Link for data and one four conductor 22 AWG cable for

power. The thermal load from the Star Tracker CCD and electronics board inside the sensors is carried by a copper “bus” to the thermal blocks connecting to the Tracker Thermal Control System. The electronics unit is based on a VME bus, which contains the processor (DSP21020) and power switching boards. The CCD front end electronics boards for each ASTC are contained in the AMICA Star Tracker Supports (ASTSs) that attach the instrument to the Tracker.

3. PRODUCTION AND QUALIFICATION HISTORY

All Star Tracker electronics have three design and production phases, engineering module (EM), qualification module (QM) and flight module (FM). The engineering module are used to verify the functions. The qualification modules are used to qualify the design and production processes. The final flight modules are installed into AMS-02 or as flight spares. We have produced two complete sets of ASTE boards and two flight cameras (ASTC).

EM did only the functional tests and one of them went through the beam tests to check the CCD detector under radiation. QM and FM productions were followed our standard procedures:

- Board level functional test
- Board conformal coating
- Board level environmental stress screening (ESS)
- Board level functional test
- Thermal vacuum test (TVT)
- Starting from QM productions, we had the following key milestones.
 - ASTE and ASTC QM were finished in 2005.
 - QM ASTC TVT test was performed Jul 2006.
 - QM ASTC EMI test was performed in Nov 2005.
 - QM ASTC vibration test was performed in Jan 2006.
 - QM ASTC thermal balance test was performed in Jan 2006.
 - The lens Sun test was performed in Jan 2006.
 - FM productions were finished in 2006.
 - ASTE FM spare acceptance test was performed in May 2006.

Complete sets of FM ASTE and two ASTCs cameras with flight cables performed ESS, TVT and vibration test in Sep 2009.

4. DOCUMENT CONTENTS

4.1 ADP STRUCTURE

This ADP consist essentially of two main parts:

PART 1

This part is normally prepared according to company standard:

- Header
- Change history records

- Distribution list
- Contents index

PART 2, Annex documentation

This part is divided in the following sections:

- Sect.1 Certificate of conformance
- Sect.2 Configuration item data list
- Sect.3 Drawings
- Sect.4 Assembly
- Sect.5 List of request for waiver/deviation (RFW/RFD) and copies
- Sect.6 Design verification and compliance matrix
- Sect.7 Test report
- Sect.8 Acceptance test report
- Sect.9 Ground support equipment (GSE) list
- Sect.10 Applicable S/W list
- Sect.11 Loose item list (not installed items & spares)

5.1 SECTIONS CONTENTS DESCRIPTION

SECT.1 Certificate of conformance

This section contain the certificate of conformance of the product versus technical, quality and contractual requirements.

SECT.2 Configuration item data list

Contain the list of the documents that define the technical characteristics, functional and operative, of the product

SECT.3 Drawings

Contain all drawings according to contractually requested

SECT.5 List of request for waiver/deviations (RFW/RFD) and copies

Contains the last status of the RFW/RFD applicable to the product and relevant copies

SECT.6 Design verification and compliant matrix

Contains the test matrix in order to verify project requirement

SECT.7 Test report

Contains copies of the test reports or as minimum the reports list and where are physically stored.

SECT.8 Acceptance Test report

Contains copies of the test reports or as minimum the reports list and where are physically stored.

SECT.9 Ground support equipment (GSE) list

Contains the list of the mechanical equipment (MGSE), electrical equipments (EGSE) or other that is necessary for the activities on the product.

SECT.10 Applicable S/W list

Contains the applicable S/W list at last S/W version.

SECT.11 Loose item list (not installed items & spare)

Contains the list of loose parts, not installed and spares provided with product.



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Sect.1 Certificate of conformance

<u>Doc. Nr.</u>	<u>Rev.</u>		<u>Doc Name</u>	<u>Description</u>	<u>Entity</u>
DRD-PA01-ANNEX01		Jul07	COC Amica AST		CARSO

Sect.2 Configuration item data list

Code	Name	Quantity	Material
240.000	AMICA STAR TRACKER		
240.001	CAMERA		
241.000	ASTB Baffle	1	ASSEMBLY
241.001	Baffle mechanics	1	PART AL 7075-T7351
241.002	Baffle Silver teflon 125um	1	PART
241.003	Baffle Internal Coating	1	PART
241.100	Baffle Support	1	ASSEMBLY AL 7075-T7351
242.100	ASTSU upper support	1	ASSEMBLY
242.101	ASTSU	1	PART CFRP:M55J/ACG LTM 110
242.102	ASTSU_EMI_shielding	1	PART
242.110	ASTSU_Side	1	ASSEMBLY
242.111	ASTSUS	1	PART CFRP:M55J/ACG LTM 110
242.112	ASTSUSW	6	PART CRES A286
242.113	ASTSUS_connectoR_Plate	1	PART AL 7075-T7351
242.120	ASTSU_Collar	1	PART AL 7075-T7351
242.121	ASTSU_Lens_set_pin	1	PART TI6AL4V
242.130	ASTSU_Back_collar	1	PART AL 7075-T7351
242.140	ASTSU_Feet_Camera_CCD	4	ASSEMBLY
242.141	ASTSU_Feet_Bolt	1	PART CRES A286
242.142	ASTSU_Feet_Washer	1	PART TI6AL4V
242.143	ASTSU_Feet_Collar_CD	1	PART TI6AL4V
242.144	ASTSU_Feet_CCD_CD1	1	PART TI6AL4V
242.150	ASTSU_Insert_Side	1	ASSEMBLY
242.151	ASTSU_Insert_Side_1	1	PART TI6AL4V
242.152	ASTSU_Insert_Side_2	1	PART TI6AL4V
242.153	ASTSU_Insert_Side_3	1	PART TI6AL4V
242.154	ASTSU_Insert_Side_4	1	PART TI6AL4V
242.155	ASTSU_Insert_Side_5	1	PART TI6AL4V
242.160	ASTSU_fix_El_board	1	ASSEMBLY
242.161	ASTSU_Pinser_Eb_1	1	PART TI6AL4V
242.162	ASTSU_Pinser_Eb_2	1	PART TI6AL4V
242.163	ASTSU_Pinser_Eb_3	1	PART TI6AL4V
242.164	ASTSU_Washer_Eb_1	1	PART TI6AL4V

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242.165	ASTSU_Washer_Eb_2	1	PART	TI6AL4V
242.166	ASTSU_Washer_Eb_3	1	PART	TI6AL4V
242.167	ASTSU_Bolt_Eb_1,2,3	3	PART	CRES A286
242.168	ASTSU_Insert_Eb_link	2	PART	TI6AL4V
242.169	ASTSU_Washer_Eb_lin k	2	PART	G10
242.170	ASTSU_Insert_Thermal	1	ASSEMBLY	
242.171	ASTSU_Insert1_T_CC D	1	PART	TI6AL4V
242.172	ASTSU_Insert2_T_CC D	1	PART	G10
242.180	ASTSU_Interface_Low	8	ASSEMBLY	
242.181	ASTSUL_cage	1	PART	AL 7075-T7351
242.182	ASTSUL_screw	1	PART	CRES A286
242.190	ASTSU_Interface_PL1	4	ASSEMBLY	
242.191	ASTSU_PL1L	1	PART	TI6AL4V
242.192	ASTSU_PL1U	1	PART	TI6AL4V
242.193	ASTSU_Electrical_Connection	1	PART	Copper
242.200	ASTSL lower support	1	ASSEMBLY	
242.210	ASTSL	1	PART	CFRP:M55J/ACG LTM 110
242.220	ASTSL_Interface_CFL	1	ASSEMBLY	
242.221	ASTSL_I/F_CFL_insert	20	PART	TI6AL4V
242.222	ASTSL_I/F_CFL_screw	20	PART	CRES A286
242.230	ASTSL_Interface_U	1	ASSEMBLY	
242.231	ASTSL_I/F_U_insert	8	PART	TI6AL4V
243.000	ASTT thermal control	1	ASSEMBLY	
243.100	ASTT_ccd_link	1	ASSEMBLY	
243.101	ASTT_ccd_link	1	PART	CU
243.102	ASTT_ccd1_link	1	PART	CU
243.103	ASTT_ccd_Link_Wash er	1	PART	G10
243.104	ASTT_Link_bolt_CCD	1	PART	CRES A286
243.200	ASTT_electr_board_liNk	1	ASSEMBLY	
243.201	ASTT_electr_board_ST RIP	1	PART	CU
243.202	ASTT_EB_Link_bolt	2	PART	CRES A286
243.203	ASTT_EB_Link_Washe r	2	PART	G10
243.300	ASTT_Bridge	1	PART	CU
243.310	ASTT_Captive_screw	4	ASSEMBLY	
243.311	ASTT_Captive_screw_ bolt	1	PART	CRES A286
243.312	ASTT_Captive_screw_ washer	1	PART	
243.400	ASTT_Block_insulation	1	ASSEMBLY	
243.401	ASTT_Block_insulation	2	PART	G10

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244.100	ASTO Optics	1	ASSEMBLY	
244.150	lens : Heligon 1:1.25 f75	1	PART	Rodenstock
244.200	Lens Cover	1	ASSEMBLY	
244.201	Cover	1	PART	AL 7075-T7351
244.202	O-Ring 2-037	2	PART	
244.203	O-Ring 2-038	2	PART	
244.204	Ring	1	PART	AL 7075-T7351
244.210	filters	1	ASSEMBLY	
244.212	GG435+KG2	1	PART	
244.250	MLI lens	1	ASSEMBLY	kg/m2
244.251	MLI Collar	1	PART	AL 7075-T7351
244.260	CCD detector: CCD87	1	PART	Marconi
244.270	CCD light shield	1	PART	Peek
244.300	ASTCC ccd board 1	1	ASSEMBLY	
245.301	Coil Screw M3	1	PART	AL 7075-T7354
245.302	Coil Nut M3	1	PART	AL 7075-T7354
244.400	ASTCD ccd board 2	1	ASSEMBLY	
244.500	ASTCE el. board 3	1	ASSEMBLY	
	ASTCB			
244.600	Cables	1		
244.610	cable ASTC-ASTE	1	ASSEMBLY	
244.611	25 pin - MWDM-2-L- 25-P-S-L	2	PART	Glenair Glenair
244.612	cable	3,5	PART	kg/m
244.620	cable ASTC-side	1	ASSEMBLY	
244.621	9 pin - MWDM-2-L-9- P-S-L	1	PART	Glenair
244.622	15 pin - MWDM-2-L- 15-P-S-L	1	PART	Glenair
244.623	25 pin - MR75-80-25-S- 1-B-P	1	PART	Glenair
244.624	cable	1	PART	
244.630	cable ASTCE-ASTCD	1	ASSEMBLY	
244.631	25 pin - MWDM-2-L- 25-P-S-L	2	PART	Glenair
244.632	cable	1	PART	Glenair
244.640	cable ASTCE-ASTCC	1	ASSEMBLY	
244.641	9 pin - MWDM-2-L-9- P-S-L	2	PART	Glenair
244.642	cable	1	PART	Glenair
244.650	COAX cable ASTCE-ASTCC	1	ASSEMBLY	
244.651	SMA female	2	PART	
244.652	coax cable	1	PART	
244.660	cable ASTE1-ASTE2 MWDM2L-25GS-6J1- 5M			

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245.000	ASTE electronics	1	ASSEMBLY	
245.100	ASTE DSP Processor board	1	ASSEMBLY	
245.110	Front Panel	1	PART	AL 7075-T7351
245.111	Board Spacer (Solder Side)	2	PART	AL 7075-T7352
245.112	Board Spacer (Component Side)	3	PART	AL 7075-T7353
245.113	Board Stiffener	4	PART	AL 7075-T7354
245.114	Card Retainer	5	PART	Calmark 260-1334-4.80ET2K

Sect.3 Drawings

<u>Doc. Nr.</u>	<u>Rev.</u>	<u>Date</u>	<u>File Name</u>	<u>Description</u>	<u>Entity</u>
Camera					
Electronics					
AMST/ STCD /1/A	1	Oct 2006	ASTCDetailedDesign.pdf		CARSO
Filter Cover					
	3.1	12/02/07	FILTER_COVER_3p1		CARSO
Baffle					
	1	22/03/07	baffle_22_03_07.pdf	Baffle drawing	CARSO
	0	27/03/07	BAFFLE_(AMS02_BAFFLE001).pdf	Baffle & brackets	INFN
	0	27/03/07	BAFFLE_(AMS02_BAFFLE002).pdf	Bracket M-side	INFN
	0	27/03/07	BAFFLE_(AMS02_BAFFLE003).pdf	Bracket baffle side	INFN
	0	27/03/07	BAFFLE_(AMS02_BAFFLE004).pdf	Pins & bushes	INFN
Mechanics					
		25/03/05	ASTSUL_CAGE&TAP		INFN
		25/03/05	ASTSU_SIDE_INSERTS		INFN
		25/03/05	ASTSU_FEET_COLLAR_CCD		INFN
		25/03/05	ASTSL_IF_U_INSERT&TH_CCD_EL		INFN
		25/03/05	ASTSL_IF_CFL_INSERTS		INFN



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		25/03/05	ASTS_G10_WASHER&INSERTS			INFN
		25/03/05	ASTS_CONNECTOR_PLATE			INFN
		25/03/05	ASTS_COLLAR_BACKCOLLAR			INFN
ASTE						
AMST/ STED /1/A	6	Oct 2006	ASTEDetailedDesign6.pdf			CARSO
		19/10/06	ASTE_FrontPanel.pdf			CARSO
	6	01/06/06	Backplane.pdf			RWTH
Wiring						
AMIA/WISC/1/A	1.5	18/12/2006	AST_wiring1P5.pdf			CARSO

Sect.4 Assembly

<u>Doc. Nr.</u>	<u>Rev.</u>	<u>Date</u>	<u>File Name</u>	<u>Description</u>	<u>Entity</u>
Camera					
CARIN090612	1.0	Jun 12, 2009	CARIN090612.pdf	Camera assembly	CARSO
AST-FL-FOC-12	1.2	Oct 2009	AST-FL-FOC-12-ASTC-lens-focus.pdf	AMS02 - AST STAR TRACKER ASTC focusing	CARSO
TCS000001	1.15	24 Oct 2009	ATS-Star tracker-TCS000001-1-15.pdf	Flight Thermocouples installation	CARSO
AST/NCR002	1	JUL2009	NCR002.pdf	Non Conformance Report	CARSO
AST/ECO002	1	JUL2009	ECO002.pdf	Engineering change order	CARSO
AST/NCR004	1	NOV 2009	NCR004.pdf	Non Conformance Report	CARSO
AST/ECO004	1	NOV2009	ECO004.pdf	Engineering change order	CARSO



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Sect.5 List of request for waiver/deviation (RFW/RFD) and copies



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Sect.6 Design verification and compliance matrix

Sect.7 Test report

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Emi test					
AMIA/CEMT/1/A	1	14/11/2005	ASTCEMI.pdf	QM ASTC EMI test	CARSO
Vibration test					
AMST/ACQFV/1/A	1	27/01/2006	QM_ASTC_Vibr_Func_test.pdf	QM ASTC vibration test	CARSO
		26/01/06	VIBRPT30_S0100R_26JAN2K6.pdf		SERMS
VIBRPT78-S3022R-2SETT09	1	02/09/09	VIBRPT78-S3022R-2SETT09.pdf		SERMS
VIBRPT73-S3022R-2SETT09	1	02/09/09	VIBRPT73-S3022R-2SETT09.pdf		SERMS
Thermal test					
Cycling					
		05/01/06	THERMAL VACUUM CYCLING TEST PROCEDURE		CARSO
AMS_02_AST_050106_re v2	2	05/01/06	Star_Tracker_REV2_TV_tets_Plan__050106.pdf		INFN
	A01	07/03/06	AST_TB_heaters_design_A01.doc	Description of method of	SERMS



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				heaters design	
AMST/ASTP/1/A	1	12/04/2006	ASTEFuncTestProcedure.doc	ASTE FUNC TEST procedure	CARSO
AMST/ASTT/1/A	1	21/04/2006	ASTEFuncTest.pdf	ASTE FUNC TEST	CARSO
AMIA/CTVC/1/A	1	26/07/06	ASTCFuncThCycling.pdf	FUNCTIONAL THERMAL CYCLING TEST ON AMICA ELECTRONICS	CARSO
		05/01/06	Stra_Tracker_APPENDIX1rev2_TV_tets_Plan__ 050106	LENS COLD TEST PROCEDURE	CARSO
	A01	06/07/06	ENVRPT_ST-06JULY2K6	ENVIRONMENTAL TEST REPORT	SERMS
ENVRPT_ST-06JULY2K6	A01	Jul 07	ENVRPT_ST-06JULY2K6.pdf	ENVIRONMENTAL TEST REPORT	SERMS
Balance					
AMIA/CTVB/1/A	1		ASTCFuncThbalance.doc	QM ASTC Thermal balance	CARSO
ENVRPT_ST_TB_11JUL Y07	A01	11/07/07	ENVRPT_ST_TB_11JULY07.pdf	ENVIRONMENTAL TEST REPORT	SERMS
Lens					
AMIF/LETV/1/A	1	23/10/2006	LensVacuumTests.pdf		CARSO
AMST/CTVL/1/A	1	19/07/2006	LensThermalCold.pdf		CARSO
ASTE					
AMST/ASTP/1/A	1	12/04/06	ASTEFuncTestProcedure.pdf		CARSO
AMST/ASTT/1/A	1	21/04/06	ASTEFuncTest		CARSO
		05/06	ASTE Test Results 200605		CERN

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		05/06	ASTE Test Report 200605		CERN
AMST/AST2/1/A		19/04/06	TestReportSerial	ASTE TEST: SERIAL PORTS AND INTERNAL TIMER	CARSO
AST/NCR003	1	AUG09	NCR003.pdf	Non Conformance Report	CARSO
AST/ECO003	1	AUG09	ECO003.pdf	Engineering change order	CARSO

Sect.8 Acceptance test report

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Thermal Vacuum					
AMIA/CEMT/1/A	1.1	09/2009	AST_FAT_TV.pdf	AMS-02 STAR TRACKER FLIGHT ACCEPTANCE TEST THERMAL VACUUM	CARSO
ESS					
	1.1	09/2009	AST_FAT_ESS.pdf	Environmental Stress Screening	CARSO
Vibration test					
VIBRPT78-S3022R- 2SETT09	1	02/09/09	VIBRPT78-S3022R-2SETT09.pdf		SERMS
VIBRPT73-S3022R- 2SETT09	1	02/09/09	VIBRPT73-S3022R-2SETT09.pdf		SERMS

Sect.9 Ground support equipment (GSE) list

<u>Doc. Nr.</u>	<u>Rev.</u>		<u>Doc Name</u>	<u>Description</u>	<u>Entity</u>
AMST/ STGE /1/A	2	Jun07	AsteGseSw.pdf		CARSO
AST/NCR001	1	AUG09	NCR001.pdf	Non Conformance Report	CARSO
AST/ECO001	1	AUG09	ECO001.pdf	Engineering change order	CARSO

Sect.10 Applicable S/W list

<u>Doc. Nr.</u>	<u>Rev.</u>		<u>Doc Name</u>	<u>Description</u>	<u>Entity</u>
AMST/ SWDS /1/A	1	Jun07	AmicaSoftware.pdf	Software description	CARSO
	1	May 06	ASTE Test Software 200605		CERN

Sect.11 Loose item list (not installed items & spares)

<i>PN</i>	<i>SN</i>	<i>Part</i>	<i>Item</i>
245.100	SSN2	ASTE	spare
244.400	SN1	ASTCD	spare
244.500	SN3	ASTCE	spare
244.150	SN3	Lens	spare
244.610	SN3	ASTC-ASTE cable	spare